

Application No. 10,820,522
Amendment dated 22 Jan 2007
Reply to FINAL Office Action of 22 Aug 2006

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (twice amended): A method for carrying out a finishing operation upon an already manufactured workpiece complex spiral gear using a machining tool controlled by a computer, said computer controlling said machining tool with a control program, said method comprising the steps of:

selecting the workpiece complex spiral gear ;

creating an inspection data file for said workpiece complex spiral gear ;

using said data file to create a model of said workpiece complex spiral gear with said control program;

selecting data points in said model to identify selected portions of the surfaces of the periphery of said workpiece complex spiral gear to be finished; and

finishing said identified surfaces with said machining tool by controlling said machining tool with said control program.

Claim 2 (twice amended): The method of Claim 1 wherein a succession of said finishing operations are carried out upon said workpiece complex spiral gear .

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Claim 3 (once amended): The method of Claim 1 wherein said finishing operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

Claim 4 (twice amended): A method for manufacturing a ~~workpiece~~ complex spiral gear from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of the ~~workpiece~~ complex spiral gear ;

5 using said first data set to set the operating parameters of a workpiece-shaping device;
cutting a prototype ~~workpiece~~ complex spiral gear from said blank with said workpiece-shaping device;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said contours of said prototype ~~workpiece~~ complex spiral gear ;

10 measuring and inspecting said contours of said prototype ~~workpiece~~ complex spiral gear using a device operated by said second computer program;

using a third computer program to create a digital model of said contours of said ~~workpiece~~ complex spiral gear ; and

15 using said third computer program and said model to operate a computer-controlled machining device to perform selected finishing operations on selected of said contours.

Claim 5 (twice amended): The method of Claim 4 wherein a succession of said finishing operations are carried out upon said ~~workpiece~~ complex spiral gear .

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Claim 6 (previously amended) The method of Claim 4 wherein said finishing operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

Claim 7 (original): A method for manufacturing a complex spiral gear from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of said gear;

5 using said first data set to set the operating parameters of a gear-cutting machine;

cutting a gear from said blank with said gear-cutting machine;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said gear;

10 measuring and inspecting said gear by a gear-inspection machine operated by said second computer program;

mounting said gear to a rotatable, indexable chuck;

using a third computer program to generate a computer model of the contours of said gear,

15 said third computer program adapted to operate said indexable chuck and a robotic work arm;

mounting a first selected machining tool on said robotic work arm;

using said third computer program to operate said work arm to bring said first machining tool into contact with a first selected portion of said gear contours;

conducting a first machining operation upon said first gear contour portion;

20 operating said indexable chuck to bring a second selected portion of said gear contour into position to be machined;

using said third computer program to operate said work arm to bring said first machining

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tool into contact with said second selected portion of said gear contours;

conducting said first machining operation upon said second gear contour portion; and

25 continuing to reindex and machine said gear until all contours desired to be machined
have been machined.

Claim 8 (original). The method of Claim 7 including the steps of:

removing said first machining tool and replacing it with a second machining tool to carry
out a second machining operation;

5 using said third computer program to operate said work arm to bring said second
machining tool into contact with a third selected portion of said gear contours;

conducting said second machining operation upon said third gear contour portion;

operating said indexable chuck to bring a fourth selected portion of said gear contour into
position to be machined;

10 using said third computer program to operate said work arm to bring said second
machining tool into contact with said second selected portion of said gear contours;

conducting said second machining operation upon said fourth gear contour portion; and

continuing to reindex and machine said gear until all contours desired to be machined
have been machined.

Claim 9. (original) The method of Claim 7 wherein said machining operation is selected from
the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

Claim 10 (original). The method of Claim 8 wherein said machining operation is selected from
the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

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Claim 11 (original). A method for manufacturing a complex spiral gear from a blank, said method comprising the steps of:

using a first computer program to create a first data set that identifies the contours of said gear;

5 using said first data set to set the operating parameters of a gear-cutting machine;

cutting a prototype gear from said blank with said gear-cutting machine;

using a second computer program to generate a second data set for the purpose of measuring and inspecting said prototype gear;

measuring and inspecting said prototype gear with a gear-inspection machine operated by

10 said second computer program;

correcting any detected errors in said prototype gear by resetting said gear-cutting

machine operating parameters and manufacturing a second prototype gear;

repeating said prototype manufacture and inspection steps until a final of said prototype gears meets desired gear specifications;

15 using a third computer program to generate a computer model of the contours of said final prototype gear,

said third computer program adapted to operate an indexable chuck and a robotic work arm;

using said gear-cutting machine parameters to cut a production gear;

20 mounting said production gear to said rotatable, indexable chuck;

mounting a selected machining tool on said robotic work arm;

using said third computer program to operate said robotic work arm to bring said machining tool into contact with a first selected portion of the contours of said production gear;

carrying out a first machining operation upon said first production gear contour portion;

25 operating said indexable chuck to bring a second selected portion of said production gear

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contour into position to be machined;

using said third computer program to operate said work arm to bring said machining tool into contact with said second selected portion of said production gear contours;

carrying out said first machining operation upon said second selected production gear contour portion; and

continuing to reindex and machine said production gear until all contours desired to be machined have been machined.

Claim 12 (original). The method of Claim 11 wherein a succession of said machining operations are carried out upon said workpiece.

Claim 13 (original). The method of Claim 11 wherein said machining operation is selected from the group of chamfering deburring, honing, reaming, grinding, polishing, buffing and drilling.

Claim 14 (original). Apparatus for manufacturing a workpiece from a blank, said apparatus comprising:

a cutting machine having machine settings adjustable to cut the contours of said workpiece from said blank;

a first computer program to create a first data set that identifies said contours of said workpiece,

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10 said cutting machine settings determined by said first data set;
 an inspection machine adapted to perform measurements upon said workpiece contours,
 a second computer program to transform said measurements into a second data set;
 a robotically-controlled machining arm,
 said arm adapted to receive and operate a multiplicity of machining tools responsive to a
third computer program;
 an indexable chuck adapted to hold said workpiece and rotate said workpiece to bring
said workpiece into a selected position;
15 a third computer program to control the movements of said arm and said chuck,
 said third computer program adapted to use said second data set to control said chuck and
said arm whereby a selected of said tools is brought into contact with a first selected portion of
said contours to carry out a machining operation upon said contour and said chuck is operated to
bring successive portions of said contours into position to be machined until all contours desired
20 to be machined have been machined.

Claim 15 (original). The apparatus as recited in Claim 14 further comprising a work cabinet
within which said arm and said chuck are positioned.

Claim 16 (original). The apparatus as recited in Claim 15 further comprising means for
collecting dust and debris created by said machining operation,

5 said collecting means including a hood forming the upper portion of said cabinet,
 an air inlet formed through said hood;
 a cabinet base having an air outlet;
 a vacuum filtration unit; and
 a duct extending from said air outlet to said filtration unit.

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Claim 17 (original). The apparatus as recited in Claim 14 further comprising means for cooling said workpiece during said machining operation;

said cooling means including means for supercooling ambient air;

means for directing said supercooled air to impinge upon said workpiece proximate the
5 site of said machining operation.

Claim 18 (original). The apparatus of Claim 14 wherein said machining tools include tools to carry out the operations of chamfering, deburring, honing, reaming, grinding, polishing, buffing and drilling.

Claim 19: (canceled)